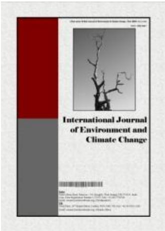

International Journal of Environment and Climate Change

11(12): 344-349, 2021; Article no.IJECC.75567
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Effect of Micronutrients on Growth of Onion (*Allium cepa* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2021/v11i1230585
Editor(s):
(1) Dr. Wen-Cheng Liu, National United University, Taiwan.
Reviewers:
(1) Swapnil Pandey, Regional Research Station (Punjab Agricultural University, Ludhiana), India.
(2) D. Prabha, Tamilnadu Agricultural University, India.
Complete Peer review History, details of the editor(s), Reviewers and additional Reviewers are available here:
https://www.sdiarticle5.com/review-history/75567

Original Research Article

Received 08 August 2021
Accepted 19 October 2021
Published 20 December 2021

ABSTRACT

Onion is one of the most important bulb crop grown all over the India. It belongs to family Alliaceae and locally known as Pyaj. An experiment was conducted to determine the effect of micronutrients on growth of Onion (*Allium cepa* L.) during *Rabi* season of 2019-2020 at the Horticultural Research centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.). The experiment was laid out in Randomized Block Design (RBD) with three replications. The maximum plant height (27.18, 43.32, 49.22 and 47.45 cm at 30, 60, 90 and at harvest after days of transplanting, respectively), number of leaves (5.11, 8.83, 12.87 and 13.98 at 30, 60, 90 and at harvest after days of transplanting, respectively), diameter of stem per plant (6.64, 8.97, 11.13 and 10.95 mm at 30, 60, 90 and at harvest after days of transplanting, respectively) and length of longest leaf at harvesting (43.56 cm) were reported under treatment T_9 -RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1} whereas the minimum values for above parameters were recorded under T_{11}- control. Hence application of RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1} is worth recommendable for formers to get significantly better growth of *Rabi* onion.

Keywords: Onion; RDF; Zinc; borax and growth.

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1. INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important commercial bulbous vegetable crop which is cultivated extensively in India. Though onion is a cool season vegetable crop, it can be successfully grown under a wide range of agro-climatic conditions. It grows well under a mild climate without extreme heat or cold or extreme rainfall. The edible part of the onion is green leaves (green onion or scallions), immature and mature bulbs. Onion has strong flavor due to the presence of sulphur containing compounds in very small quantities in the form of volatile oil allyl propyl disulphide responsible for distinctive smell and pungency.

In India, onion is cultivated for vegetable as well as medicinal purposes. Its medicinal properties are steadily gaining more importance in the world. It has benefits in lowering total plasma cholesterol, reducing blood pressure, regulating blood sugar, acts as blood purifier etc. Onion is one of the richest sources of flavonoids which reduce risk of cancer, heart disease and diabetes. Flavonoids are not only anti-cancer but also known as anti-bacterial, antiviral and anti-allergenic. Most of the medicinal effects of onion are preferable to a sulphur compound known as allicin [1], which is influenced by both genetic and agronomical practices.

Plant nutrients play an important role in growth and development of onion. Beside the major plant nutrients like nitrogen, phosphorus and potassium, some micronutrients also impart a beneficial effect in terms of plant metabolic process from cell wall development to respiration, photosynthesis, chlorophyll formation, enzyme activity, nitrogen fixation etc. Also, they work as a coenzyme for a large number of enzymes. In addition to that, they play an essential role for better plant growth parameters of different crops [2].

The application of nitrogen increased plant growth of onion. Similarly, phosphorus has the most beneficial effect on early root development and plant growth of crop produce. Potassium plays an important role in crop productivity by functioning as an activator of numerous enzymes like pyruvic kinase, cytoplasmic enzymes and therefore, causes a pervasive effect on metabolic events. The judicious application of nutrient like sulphur has improved plant height and number of leaves of onion [3].

Zinc is a micronutrient which is required for plant growth and development relatively in small amounts. The functional role of Zinc include auxin metabolism, influence on the activity of dehydrogenase, carbonic anhydrase enzymes, synthesis of cytochrome and stabilization of ribosomal fractions. Zinc also plays an important role in chlorophyll formation. Application of Zinc increased the growth of onion [4].

Boron is an essential micronutrient required for normal plant growth and development. It is a very sensitive element and plants differ widely in their requirements but the ranges of deficiency and toxicity are narrow. It is necessary for normal cell division, nitrogen metabolism and protein formation. It is essential for proper cell wall formation [5]. Therefore, an experiment was made to study the “Effect of micronutrients on growth of Onion (*Allium cepa* L.).”

2. MATERIALS AND METHODS

A field experiment was conducted during *Rabi* season of 2019-2020 at the Horticultural Research centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.). Onion variety Agrifound Light Red was used to conduct the experiment in Randomized Block Design (RBD) with eleven treatments in three replications. The crop was planted in a net plot size (3.50 m x 1.25 m) at a spacing of 15 cm x 10 cm. Before fertilizer application, random soil samples were taken from the experimental field and were analyzed. The soil of the experimental plot was sandy loam in texture with pH 7.68. Nitrogen (153.40 kg ha^{-1}) and Organic carbon (0.42 %) content in soil were low. while, the level of available phosphorus (24.30 kg ha^{-1}) and potassium (114.80 kg ha^{-1}) was medium. The treatments includes **T_1-** RDF(100:50:50:30 Kg NPKS + 20 tones FYM ha^{-1}), **T_2** - RDF + Zinc Sulphate 10 Kg ha^{-1}, **T_3** - RDF + Zinc Sulphate 20 Kg ha^{-1}, **T_4** - RDF + Zinc Sulphate 30 Kg ha^{-1}, **T_5** - RDF + Borax 5 Kg ha^{-1}, **T_6** - RDF + Borax 10 Kg ha^{-1}, **T_7** - RDF + Borax 15 Kg ha^{-1}, **T_8** - RDF + Zinc Sulphate 10 Kg ha^{-1} + Borax 5 Kg ha^{-1}, **T_9** - RDF+ Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1}, **T_{10}**-RDF+ Zinc Sulphate 30 Kg ha^{-1} + Borax 15 Kg ha^{-1} and **T_{11}**- Control. Five plants were selected from each plot randomly as a unit for observation on growth parameters. The following Statistical method was used during the investigation.

2.1 Standard Error of Mean

Standard error of mean was calculated as follows-

$$\text{Standard error of mean } (\text{SEm}) = \frac{\sqrt{EMSS}}{r}$$

Where,

SEm ($\pm$) = Standard error of mean
EMSS **=**Error mean sum of square
r = Number of replication on which the observation is based

2.2 Critical Difference

The critical difference at 5% level of probability was worked out to compare treatments means wherever "F" test will be significant.

Critical difference =SEm ($\pm$) x $\sqrt{2}$ x t (at error degree of freedom)

3. RESULTS AND DISCUSSION

In present investigation, a significant difference has been observed in terms of growth parameters among all the treatment as compared to control (Table 1). The highest plant height (27.18, 43.32, 49.22 and 47.45 cm) was obtained from the treatment T_9 - RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1}. While, the minimum plant height (16.27, 30.18, 33.06 and 29.85 cm) was obtained from control at 30, 60, 90 and at harvest after days of transplanting, respectively. The maximum number of leaves plant^{-1} (5.11, 8.83, 12.87 and 13.98) were recorded with the treatment T_9 - RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1} (Table 2). However, minimum numbers of leaves plant^{-1} (2.51, 4.61, 6.76 and 7.68) were recorded under control treatment at 30, 60, 90 and harvest stage after days of transplanting. Likewise, maximum diameter of stem plant^{-1} (6.64, 8.97, 11.13 and 10.95 mm) was measured with an application of T_9 - RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1} (Table 3). Moreover, minimum diameter of stem plant^{-1} (2.88, 4.39, 5.47 and 4.98 mm) was obtained in control at 30, 60, 90 and harvest of crop after days of transplanting. Similarly, the length of longest leaf plant^{-1} (43.56 cm) was measured with the treatment T_9 - RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1}.While, minimum length of longest leaf plant^{-1} (22.86 cm) was recorded under control at maturity stage of crop 9 (Table 4). It might be due to the use of optimum levels of major and micronutrients that favored the vegetative growth.

Micronutrients play an important role in many physiological processes and cellular functions in the plants. In addition to that they play a vital role in improving plant growth through biosynthesis of endogenous hormones which is responsible for promoting plant growth. Zinc is essential for the cell division and other physiological processes like photosynthesis, nitrogen metabolism and it is

Table 1. Effect of micronutrients on plant height (cm) at various successive stages of growth

Treatments	**Plant height (cm) at various successive stages of growth**			
	At 30 DAT	**At 60 DAT**	**At 90 DAT**	**At Harvest**
T_1- RDF(100:50:50:30 Kg NPKS + 20 tones FYM ha^{-1})	19.91	35.11	38.95	35.87
T_2 - RDF + Zinc Sulphate 10 Kg ha^{-1}	22.52	38.14	42.57	40.28
T_3 - RDF + Zinc Sulphate 20 Kg ha^{-1}	24.01	39.81	44.80	42.64
T_4 - RDF + Zinc Sulphate 30 Kg ha^{-1}	23.17	38.86	43.65	41.38
T_5 - RDF + Borax 5 Kg ha^{-1}	20.13	35.54	39.48	36.67
T_6 - RDF + Borax 10 Kg ha^{-1}	21.97	37.48	41.73	39.23
T_7 - RDF + Borax 15 Kg ha^{-1}	21.05	36.35	40.57	37.86
T_8 - RDF + Zinc Sulphate 10 Kg ha^{-1} + Borax 5 Kg ha^{-1}	25.76	41.68	46.95	44.82
T_9 - RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1}	27.18	43.32	49.22	47.45
T_{10}- RDF + Zinc Sulphate 30 Kg ha^{-1} + Borax 15 Kg ha^{-1}	26.93	42.93	48.53	46.62
T_{11} - Control	16.27	30.18	33.06	29.85
SEM(±)	**0.02**	**0.01**	**0.01**	**0.01**
C.D.at 5% of level	**0.06**	**0.03**	**0.03**	**0.03**

Table 2. Effect of micronutrients on number of leaves per plant at various successive stages of growth

Treatments	Number of leaves per plant at various successive stages of growth			
	At 30 DAT	At 60 DAT	At 90 DAT	At Harvest
$\mathbf{T_1}$- RDF(100:50:50:30 Kg NPKS + 20 tones FYM ha^{-1})	3.40	6.32	9.44	10.17
$\mathbf{T_2}$ - RDF + Zinc Sulphate 10 Kg ha^{-1}	4.14	7.66	11.03	11.97
$\mathbf{T_3}$ - RDF + Zinc Sulphate 20 Kg ha^{-1}	4.68	8.18	11.67	12.49
$\mathbf{T_4}$ - RDF + Zinc Sulphate 30 Kg ha^{-1}	4.54	7.93	11.36	12.23
$\mathbf{T_5}$ - RDF + Borax 5 Kg ha^{-1}	3.85	6.95	10.15	10.87
$\mathbf{T_6}$ - RDF + Borax 10 Kg ha^{-1}	3.99	7.49	10.82	11.84
$\mathbf{T_7}$ - RDF + Borax 15 Kg ha^{-1}	3.91	7.32	10.64	11.15
$\mathbf{T_8}$ - RDF + Zinc Sulphate 10 Kg ha^{-1} + Borax 5 Kg ha^{-1}	4.86	8.46	12.07	13.13
$\mathbf{T_9}$ - RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1}	5.11	8.83	12.87	13.98
$\mathbf{T_{10}}$- RDF + Zinc Sulphate 30 Kg ha^{-1} + Borax 15 Kg ha^{-1}	4.92	8.62	12.25	13.64
$\mathbf{T_{11}}$ - Control	2.51	4.61	6.76	7.68
SEM(±)	**0.01**	**0.02**	**0.01**	**0.01**
C.D.at 5% of level	**0.04**	**0.07**	**0.04**	**0.03**

Table 3. Effect of micronutrients on diameter of stem per plant (mm) at various successive stages of growth

Treatments	Diameter of stem per plant (mm) at various successive stages of growth			
	At 30 DAT	At 60 DAT	At 90 DAT	At Harvest
$\mathbf{T_1}$- RDF(100:50:50:30 Kg NPKS + 20 tones FYM ha^{-1})	5.13	6.96	8.65	8.23
$\mathbf{T_2}$ - RDF + Zinc Sulphate 10 Kg ha^{-1}	6.11	8.13	9.94	9.58
$\mathbf{T_3}$ - RDF + Zinc Sulphate 20 Kg ha^{-1}	6.32	8.49	10.36	10.04
$\mathbf{T_4}$ - RDF + Zinc Sulphate 30 Kg ha^{-1}	6.21	8.32	10.13	9.73
$\mathbf{T_5}$ - RDF + Borax 5 Kg ha^{-1}	5.91	7.82	9.12	8.64
$\mathbf{T_6}$ - RDF + Borax 10 Kg ha^{-1}	5.95	8.03	9.66	9.21
$\mathbf{T_7}$ - RDF + Borax 15 Kg ha^{-1}	5.96	7.94	9.27	8.90
$\mathbf{T_8}$ - RDF + Zinc Sulphate 10 Kg ha^{-1} + Borax 5 Kg ha^{-1}	6.48	8.56	10.68	10.36
$\mathbf{T_9}$ -RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1}	6.64	8.97	11.13	10.95
$\mathbf{T_{10}}$- RDF + Zinc Sulphate 30 Kg ha^{-1} + Borax 15 Kg ha^{-1}	6.56	8.75	10.88	10.59
$\mathbf{T_{11}}$ - Control	2.88	4.39	5.47	4.98
SEM(±)	**0.01**	**0.01**	**0.01**	**0.01**
C.D.at 5% of level	**0.04**	**0.04**	**0.03**	**0.03**

also a part of several other enzymes such as superoxide dismutase and catalase, which prevents oxidative stress in the plant cells. Zinc plays an important role in production of tryptophan which in turn is a precursor of auxin, which acts as essential growth hormone for proper growth of plant. The above facts that the optimum use of micronutrient might improve all growth parameters in present investigation. Similar results were also indicated to support the study with earlier findings of Gamili et al. [6], Acharya et al. [7], Shukla et al. [8], Manna and Maity [9] and Maurya et al. [10].

Application of boron has beneficial effects as it helps in cell division and also increases calcium content of growing tissues thereby causing better vegetative growth. The beneficial effect of boron

Table 4. Effect of micronutrients on length of longest leaf at harvesting (cm) stages of onion

Treatments	Length of longest leaf at harvesting (cm)
T_1- RDF(100:50:50:30 Kg NPKS + 20 tones FYM ha^{-1})	30.06
T_2 - RDF + Zinc Sulphate 10 Kg ha^{-1}	35.41
T_3 - RDF + Zinc Sulphate 20 Kg ha^{-1}	38.68
T_4 - RDF + Zinc Sulphate 30 Kg ha^{-1}	36.53
T_5 - RDF + Borax 5 Kg ha^{-1}	31.37
T_6 - RDF + Borax 10 Kg ha^{-1}	34.23
T_7 - RDF + Borax 15 Kg ha^{-1}	32.78
T_8 - RDF + Zinc Sulphate 10 Kg ha^{-1} + Borax 5 Kg ha^{-1}	40.70
T_9 - RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1}	43.56
T_{10}- RDF + Zinc Sulphate 30 Kg ha^{-1} + Borax 15 Kg ha^{-1}	42.62
T_{11} - Control	22.86
SEM(±)	**0.12**
C.D.at 5% of level	**0.34**

on growth parameters were also reported by Smriti et al. [5], Manna et al. [11], Acharya et al. [7] and Bhat et al. [12].

Therefore, the combined effect of zinc and boron was found to be most superior in comparison with single effect and control. These findings also are in close conformity with the earlier findings of Alam et al. [13], Manna et al. [11], Acharya et al. [7], Prusty et al. [14] and Mandal et al. [15].

4. CONCLUSION

On the basis of results summarized above, it can be concluded that the treatment T_9 - RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1} was found to be most superior in terms of plant height (cm), number of leaves plant $^{-1}$, diameter of stem plant (mm) and length of longest leaf at harvesting (cm). Therefore, it is suggested that a dose of RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1} can be recommended for onion growers of Western Uttar Pradesh.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Schulz V Garlic, Hansel R, Tayler VE. (Eds), Rational Plant Therapy. A Physician Guide to Herbal Medicine.3rd ed. Springer, Berlin. 1998;107-125.
2. Ballabh K, Rana DK. Response of micronutrients on qualitative and quantitative parameters of onion (*Allium cepa* L.).Progressive Horticulture. 2012; 44(1):40-46.
3. Kumar A, Ram RB, Maji S, Kishore S, Yadav R, Meena KR. Effect of organic manures, biofertilizers and micronutrients on growth, yield and quality of onion (*Allium cepa* L.). International Journal of Agricultural Sciences. 2017; 13(2):236-241.
4. Phor SK, Pandey UC, Verma U. Effects of zinc on the growth and yield of garlic (*Allium sativum* L). Crop Research Hisar. 1995;9(2):286-291.
5. Smriti S, Kumar R, Singh SK. Effect of sulphur and boron nutrition on growth, yield and quality of onion (*Allium cepa* L.). Journal of Applied Biology. 2002; 12(1/2):40-46.
6. Gamelli EL, Hanna N, Hadi EL. The effect of some foliar fertilizers application on growth, bulb yield, quality and storage ability of onion. Journal of Horticulture. 2000;12:30-38.
7. Acharya U, Venkatesan K, Saraswathi T, Subramanian KS. Effect of zinc and boron application on growth and yield parameters of multiplier onion (*Allium cepa* L. var aggregatum Don.) var. CO (On) 5. International Journal of Research. 2015; 2(1):757-765.
8. Shukla L, Bose US, Ahirwar MK. Effect of foliar feeding of micronutrients on growth, yield and income from rabi onion var. Agrifound Light Red. Annals of Plant and Soil Research. 2015;17(3):307-310.

9. Manna D, Maity TK. Growth, yield and bulb quality of onion (*Allium cepa* L.) in response to foliar application of boron and zinc. Journal of Plant Nutrition. 2016; 39(3):438-441.
10. Maurya PK, Yadav LM, Thakur G, Patel P. Effect of Micronutrient Application on Growth and Yield of Kharif Onion (*Allium cepa* L.). International Journal of Current Microbiology and Applied Sciences. 2018; 7(3):601-608.
11. Manna D, Maity TK, Ghosal A. Influence of foliar application of boron and zinc on growth, yield and bulb quality of onion (*Allium cepa* L.). Journal of Crop and Weed. 2014;10(1):53-55.
12. Bhat TA, Chattoo MA, Mushtaq F, Akhter F, Mir SA, Zargar MY, et al. Effect of zinc and boron on growth and yield of onion under temperate conditions. International Journal of Current Microbiology and Applied Sciences. 2018;7(4):3776-3783.
13. Alam MN, Abedin MJ, Azad MAK. Effect of micronutrients on growth and yield of onion under calcareous soil environment. International Research Journal of Plant Science. 2010;1(3):56-61.
14. Prusty M, Mishra N, Samal S, Kar DS. Effect of zinc and boron on growth, yield, bulb quality and nutrient uptake of onion (*Allium cepa* L.) cv Bhima Super under Mid-Central Table Land Zone of Odisha, India. International Journal of Current Microbiology and Applied Sciences. 2020; 9(6):1403-1412.
15. Mandal J, Acharyya P, Bera R, Mohanta S. Response of Onion to NPK, S and Micronutrients. International Journal of Current Microbiology and Applied Sciences. 2020;9(6):1137-44.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/75567